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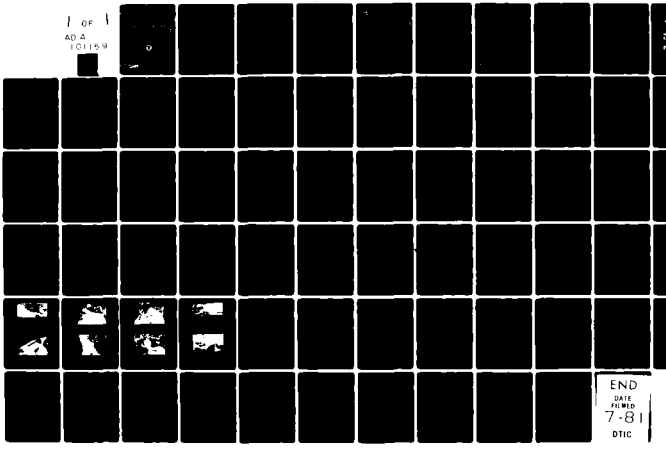

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WALLKILL RIVER BASIN
TRIBUTARY TO WALLKILL RIVER
SUSSEX COUNTY
NEW JERSEY

LAKE GRINNEL DAM
NJ00289

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DAWC 61-79-C-0011

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DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

REPT NO: DAEN/NAP-53842/NJ00289-81/07

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Dams	National Dam Safety Program	Masonry
Embankments	Lake Grinnel Dam, N.J.	
Visual Inspection	Spillways	
Structural Analysis	Embankment	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

15 JUN 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Grinnel Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Grinnel Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillways are considered inadequate because a flow equivalent to two percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) Trees and adverse vegetation on the embankment should be removed.

(2) Debris on the downstream side of dam and in the stone masonry ruins should be removed.

(3) The eroded area on the downstream side of dam at the right end should be properly filled and stabilized.

NAPEN-N
Honorable Brendan T. Byrne

(4) The stone masonry ruins located at the toe of dam should be investigated to assess its effect on the stability of the dam. Based on the results of the investigation remedial measures should be determined and then implemented.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE GRINNEL DAM (NJ00289)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 19 December 1980 by Storch Engineers, under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Grinnel Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillways are considered inadequate because a flow equivalent to two percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) Trees and adverse vegetation on the embankment should be removed.

(2) Debris on the downstream side of dam and in the stone masonry ruins should be removed.

(3) The eroded area on the downstream side of dam at the right end should be properly filled and stabilized.

(4) The stone masonry ruins located at the toe of dam should be investigated to assess its effect on the stability of the dam. Based on the results of the investigation remedial measures should be determined and then implemented.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED: _____
JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

DATE: 15 June 1981

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Grinnel Dam, NJ00289
State Located:	New Jersey
County Located:	Sussex
Drainage Basin:	Wallkill River
Stream:	Tributary to Wallkill River
Date of Inspection:	December 19, 1980

Assessment of General Condition of Dam

Based on available records, past operational performance, visual inspection and Phase I engineering analysis, Lake Grinnel Dam is assessed as being in fair overall condition.

Based on investigations of the downstream flood plain made in connection with this report, it is recommended that the hazard potential classification be downgraded from high to significant hazard.

Hydraulic and hydrologic analyses indicate that the spillways are inadequate. Discharge capacity of the spillways is not sufficient to pass the designated spillway design flood (100-year storm) without an overtopping of the dam. The spillways are capable of passing approximately 1 percent of the SDF. Therefore, the owner should engage a professional engineer experienced in the design and construction of dams in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of the analyses, the need for and type of remedial measures should be determined and then implemented.

The owner should, in the near future, develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam.

The stone masonry ruins located at the toe of dam should be investigated in the near future to assess its effect on the stability of the dam. Based on the results of the investigation, remedial measures should be determined and then implemented.

In addition, it is recommended that the following remedial measures be undertaken in the near future:

1) Trees and adverse vegetation on the embankment should be removed.

2) Debris on the downstream side of dam and in the stone masonry ruins should be removed.

3) The eroded area on the downstream side of dam at the right end should be properly filled and stabilized.

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

Richard J. McDermott, P.E.

John E. Gribbin, P.E.

OVERVIEW - LAKE GRINNEL DAM

20 JANUARY 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydraulic and hydrologic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydraulic and hydrologic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LAKE GRINNEL DAM, I.D. NJ00289

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Lake Grinnel Dam was made on December 19, 1980. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description of Dam and Appurtenances

The facilities at Lake Grinnel Dam consist of an earthfill embankment serving as support for a paved public roadway. The principal spillway consists of a set of timber stoplogs fitted at the upstream end of a box culvert near the center of the dam while the auxiliary spillway consists of a pipe culvert at the right end of the dam.

The earthfill embankment is approximately 195 feet long with a crest width varying from 49 feet to 69 feet. The height of dam is 12.1 feet.

The principal spillway, which also serves as outlet works for the dam, consists of a concrete box culvert fitted with timber stoplogs having a length of 2.4 feet. The auxiliary spillway is an 18±inch CMP culvert with a rock-lined approach channel. The principal spillway crest elevation is 558.0, National Geodetic Vertical Datum (N.G.V.D.), while the elevation of the crest of dam is 560.1.

b. Location

Lake Grinnel Dam is located in the Township of Sparta, Sussex County, New Jersey. Primary access to the dam is by West Mountain Road which traverses the embankment about 2000 feet east of N.J. Route 94.

c. Size and Hazard Classification

The dam is classified in accordance with criteria presented in "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers. Size categories consist of Small, Intermediate and Large while hazard categories are designated as Low, Significant and High.

Size Classification: Lake Grinnel Dam is classified as "Small" size since its maximum storage volume is 255 acre-feet (which is less than 1000 acre-feet) and its height is 12 feet (which is less than 40 feet).

Hazard Classification: Visual inspection of the downstream flood plain of the dam indicates that failure of the dam due to overtopping could partially inundate the dwelling and two farm buildings located adjacent to the downstream channel 4700 feet from the dam. Accordingly, Lake Grinnel Dam is classified as "Significant" Hazard.

d. Ownership

Lake Grinnel Dam is owned by the Lake Grinnel Assoc., c/o Doretta Morrow, 58 Fieldstone Dr., Lafayette, N.J. 08848.

e. Purpose of Dam

The purpose of the dam is the impoundment of a recreational lake facility.

f. Design and Construction History

Reportedly, a timber dam was constructed prior to 1900 to supply water to a mill. When the timber dam, which was located a short distance upstream from a road embankment, breached, the lake became impounded by the embankment. The embankment forms the present dam.

g. Normal Operational Procedure

Reportedly, stoplogs are sometimes pulled during times of high lake level to augment the spillway capacity. The lake is not normally lowered for maintenance purposes. Normal maintenance

consists of removal of debris from the spillways. Operation and maintenance are performed by Lake Grinnel Association personnel.

1.3 Pertinent Data

a.	Drainage Area	2.77 square miles
b.	Discharge at Damsite	
	Maximum flood at damsite	Unknown
	Outlet works at normal pool elevation	N.A.
	Spillway capacity at top of dam	30 c.f.s.
c.	Elevation (N.G.V.D.)	
	Top of Dam	560.1
	Maximum pool - design surcharge	562.9
	Principal spillway crest	558.0
	Secondary spillway - Approach channel invert	558.0
	- Culvert invert	556.5
	Streambed at toe of dam	548.0
	Maximum tailwater	555 (Estimated)
d.	Reservoir Length	
	Length of design surcharge	3500 feet (estimated)
	Length of normal pool	3000 feet (scaled)
e.	Storage (Acre-feet)	
	SDF maximum stage	413
	Normal pool	150
	Top of dam	255

f. Reservoir Surface (acres)

SDF maximum stage	55.0 (Estimated)
Normal pool	46.4
Top of dam	53.3 (Estimated)

g. Dam

Type	Earthfill
Length	195 feet
Height	12.1 feet
Sideslopes - Upstream	Unknown
- Downstream	1 horiz. to 1 vert.
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Principal Spillway

Type	Timber Weir (Stoplogs)
Length of weir	2.4 feet
Crest elevation	558.0
Gates	Stoplogs
Approach channel	N.A.
Discharge channel	Concrete box culvert

j. Secondary Spillway

Type	Corrugated Metal Pipe
Diameter	18 inches
Invert elevation	556.5
Gates	None

Approach channel	Rectangular channel with stone rubble sides and rock lined bottom.
Downstream channel	Culvert discharges onto boulders on downstream face of dam.

k. Regulating Outlet

Stoplogs in principal spillway

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original design of the dam could be obtained.

2.2 Construction

No data or reports pertaining to the construction of the dam could be obtained.

2.3 Operation

No data or reports pertaining to the operation of the dam could be obtained.

2.4 Evaluation

a. Availability

No data or reports pertaining to the operations of the dam are available.

b. Adequacy

Available engineering data pertaining to Lake Grinnel Dam is not adequate to be of significant assistance to the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

The validity of engineering data cannot be assessed due to the absence of data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

Lake Grinnel Dam was inspected on December 19, 1980 by members of the staff of Storch Engineers. A copy of the visual inspection checklist is contained in Appendix 1. The following procedures were employed for the inspection:

1) The embankment of the dam, appurtenant structures and adjacent areas were examined.
2) The embankment and accessible appurtenant structures were measured and key elevations were determined by surveyor's level.
3) The embankment, appurtenant structures and adjacent areas were photographed.
4) The downstream flood plain was toured to evaluate downstream development and restricting structures.

b. Dam

The pavement forming the roadway on the crest of the dam was in generally satisfactory condition. There were steel guide rails on either side of the pavement in the vicinity of the principal spillway. They were in satisfactory condition. The roadway pavement was slightly deteriorated at the location of the box culvert forming the principal spillway. The upstream face of the dam between the roadway and the water surface was thickly overgrown with weeds, briars and trees. The right end of the upstream face, however, was clear of growth and was stabilized by a log. The downstream side of the embankment contained a considerable amount of loose fill and debris. The downstream side of the embankment was also overgrown with

briars and trees. Evidence of erosion was observed at the extreme right end of the dam just to the right of the discharge end of the auxiliary spillway. The erosion was due to surface runoff from the roadway.

c. Appurtenant Structures

Principal Spillway

The concrete forming the intake portion of the principal spillway appeared to be in satisfactory condition. The timber stoplogs appeared to be in satisfactory condition. A steel pipe probably used as a trash rack spans the upstream opening of the box culvert. It appeared to be in satisfactory condition. The interior surfaces of the culvert appear to be roughly constructed and not finely finished, however they also appeared to be generally sound. The concrete forming the downstream end of the culvert appeared to be in satisfactory condition and generally stable. However, the ruins of the stone building appeared to be considerably deteriorated with marginal stability.

Auxiliary Spillway

The auxiliary spillway was observed to consist of a CMP at the upstream end and a concrete pipe at the downstream end. The location of the transition between the two sections could not be determined. Also the stability of the transition could not be assessed.

d. Reservoir Area

The reservoir appeared to be completely surrounded by homesites. The shores of the reservoir were wooded and steep with grades in excess of 50 percent.

e. Downstream Channel

The downstream channel consists of a natural stream with boulders and debris in its bed and a wooded, moderately sloping flood plain. The bank of the downstream channel appeared to be about 3 feet high.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Lake Grinnel is regulated naturally by discharge through the principal and auxiliary spillways of the dam.

Reportedly, stoplogs are sometimes removed during times of high water to augment the spillway capacity. The lake is not normally lowered for maintenance purposes.

4.2 Maintenance of the Dam

Reportedly, regular maintenance of the spillways consists of the removal of debris. The spillways are inspected on a daily basis. The most recent repair consists of the replacement of stoplogs about 5 years ago.

4.3 Maintenance of Operating Facilities

Reportedly, there is no program of regular maintenance of the operating facilities.

4.4 Description of Warning System

Reportedly, no formal warning system is in use at the present time.

4.5 Evaluation of Operational Adequacy

The operation of the dam has been adequate to the extent that the dam reportedly has never been overtopped.

Maintenance documentation is poor and maintenance has been inadequate in the following areas:

1) Trees and brush on embankment not removed.

2) Debris on downstream side of dam not removed.

3) Eroded area on downstream side of dam at right end not repaired.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The quantity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff quantity, called the spillway design flood (SDF), is described in terms of return frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Gudielines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers, the SDF for Lake Grinnel Dam falls in a range of 100-year frequency to 1/2 PMF. In this case, the low end of the range, 100-year frequency, is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The SDF inflow hydrograph for Lake Grinnel Dam (See Appendix 4) was calculated by the Soil Conservation Service Triangular Unit hydrograph with the curvilinear transformation utilizing the HEC-1-DAM computer program.

General hydrologic characteristics used in this method were computed using USGS quadrangles. The drainage area contributing to the impoundment is 2.77 square miles. Most of the watershed is suburban and farm land. The SDF peak inflow was computed to be 3367 c.f.s.

The principal spillway discharge rates were computed by the use of weir and orifice formulae while the auxiliary spillway discharge rates were based on culvert flow. The total spillway discharge with lake level equal to the top of the dam was computed to be 30 c.f.s. The SDF was routed through the dam

by use of the HEC-1-DAM computer program using the modified Puls Method. In routing the SDF, it was found that the dam crest would be overtopped by a depth of 2.8 feet. Accordingly, the subject spillways are assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

Reportedly, Lake Grinnel Dam has not experienced overtopping during the past 40 years.

c. Visual Observation

At the time of the field inspection there was no evidence of recent overtopping of the dam.

d. Overtopping Potential

As indicated in paragraph 5.1.a. a storm of magnitude equal to the SDF would cause overtopping of the dam to a height of 2.8 feet over the crest of the dam. The spillways are capable of passing approximately 1 percent of the SDF with the lake level equal to the crest of dam.

e. Drawdown Data

Drawdown of the lake is accomplished by removing timber stoplogs. Total time for drawdown is estimated to be approximately 4 days. (See Appendix 4.)

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation

The dam appeared, at the time of inspection to be outwardly structurally sound although the downstream side was obscured by vegetation and debris. The ruins of a stone masonry building located at the toe of dam appeared to be marginally stable.

b. Generalized Soils Description

The generalized soils description of the site consists of recent alluvium overlying glacial recessional moraine, an unassorted and heterogeneous mixture of silt, sandy silt, and gravel, deposited at the outer edge of the ice sheet during the Wisconsin stage of continental glaciation. Also included in the soils located in the vicinity of the dam are glacial kames composed of stratified material deposited during the Wisconsin Glacial period.

c. Design and Construction Data

The analysis of structural stability and construction data for the dam is not available.

d. Operating Records

Operating records for the dam and appurtenances are not available.

e. Post Construction Changes

Post construction changes to the dam and area surrounding the dam are not known.

f. Seismic Stability

Lake Grinnel Dam is located in Seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dams," which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions, if stable under static loading conditions. This dam appeared to be generally stable under static loading conditions at the time of field inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and appendix 4, the spillways of Lake Grinnel Dam are assessed as being inadequate. The spillways are not able to pass the SDF without an overtopping of the dam.

The embankment appeared at the time of inspection, to be generally outwardly stable. The marginal stability of the ruins of a stone masonry building at the dam toe was not considered to be evidence of immediate dam instability.

b. Adequacy of Information

Information sources for this study included: 1) field investigations, 2) USGS quadrangles and 3) consultation with Lake Grinnel Association personnel. The information obtained is adequate for a Phase I Assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some of the absent data are as follows:

1) Construction and as-built drawings.
2) Description of fill material for embankment.
3) Design computations and reports.
4) Soils report for the site.
5) Inspection reports.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Lake Grinnel are not available additional data are not considered imperative for this Phase I evaluation.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a, the spillways are considered to be inadequate. It is therefore recommended that a professional engineer experienced in the design and construction of dams be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of these analyses, the need for and type of remedial measures should be determined and then implemented.

The owner should, in the near future, develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam.

In addition, it is recommended that the following remedial measures be undertaken in the near future:

1) Trees and adverse vegetation on the embankment should be removed.

2) Debris on the downstream side of dam and in the stone masonry ruins should be removed.

3) The eroded area on the downstream side of dam at the right end should be properly filled and stabilized.

b. Maintenance

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

c. Additional Studies

The stone masonry ruins located at the toe of dam should be investigated in the near future to assess its effect on the stability of the dam. Based on the results of the investigation remedial measures should be determined and then implemented.

PLATES

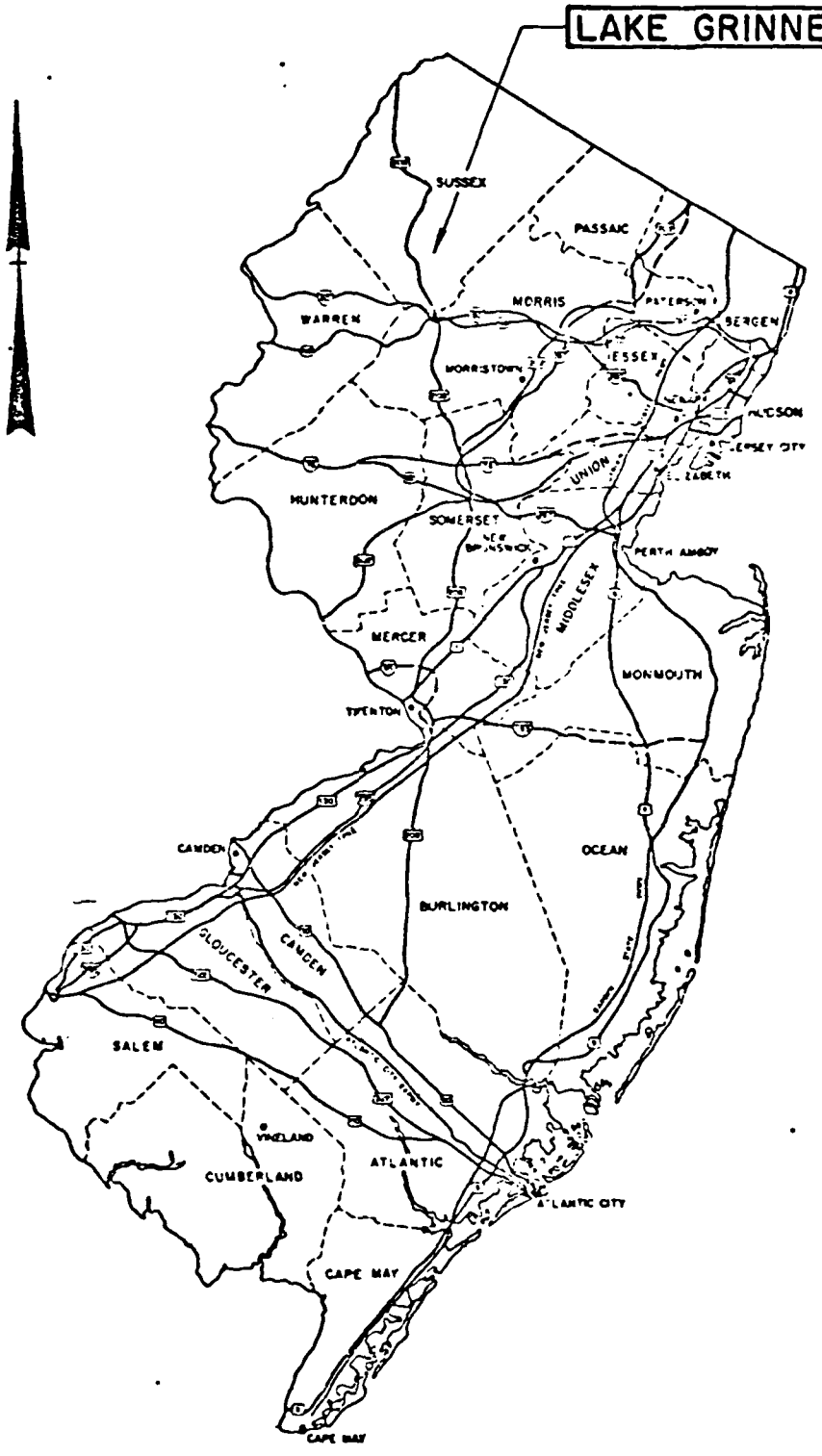
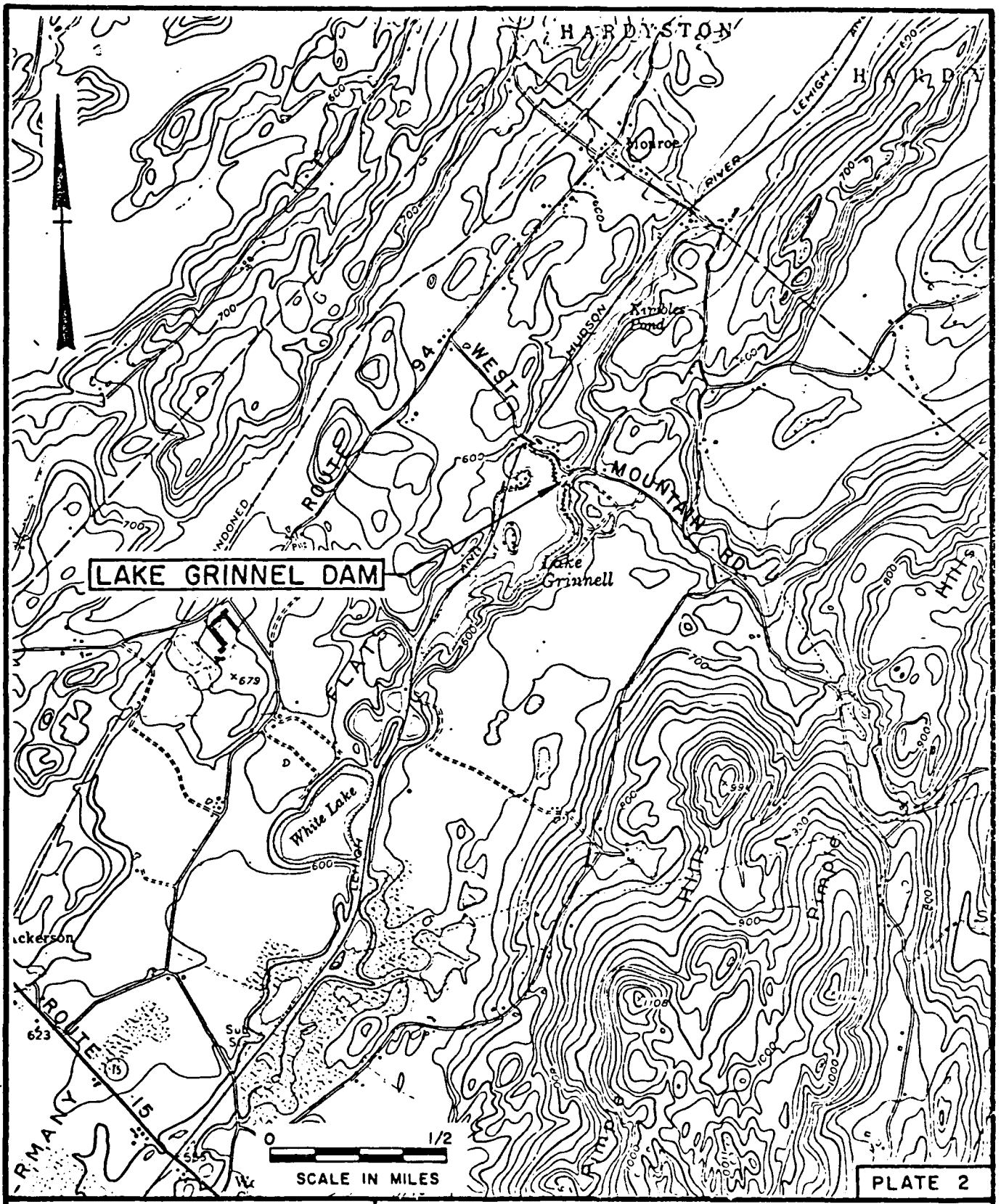
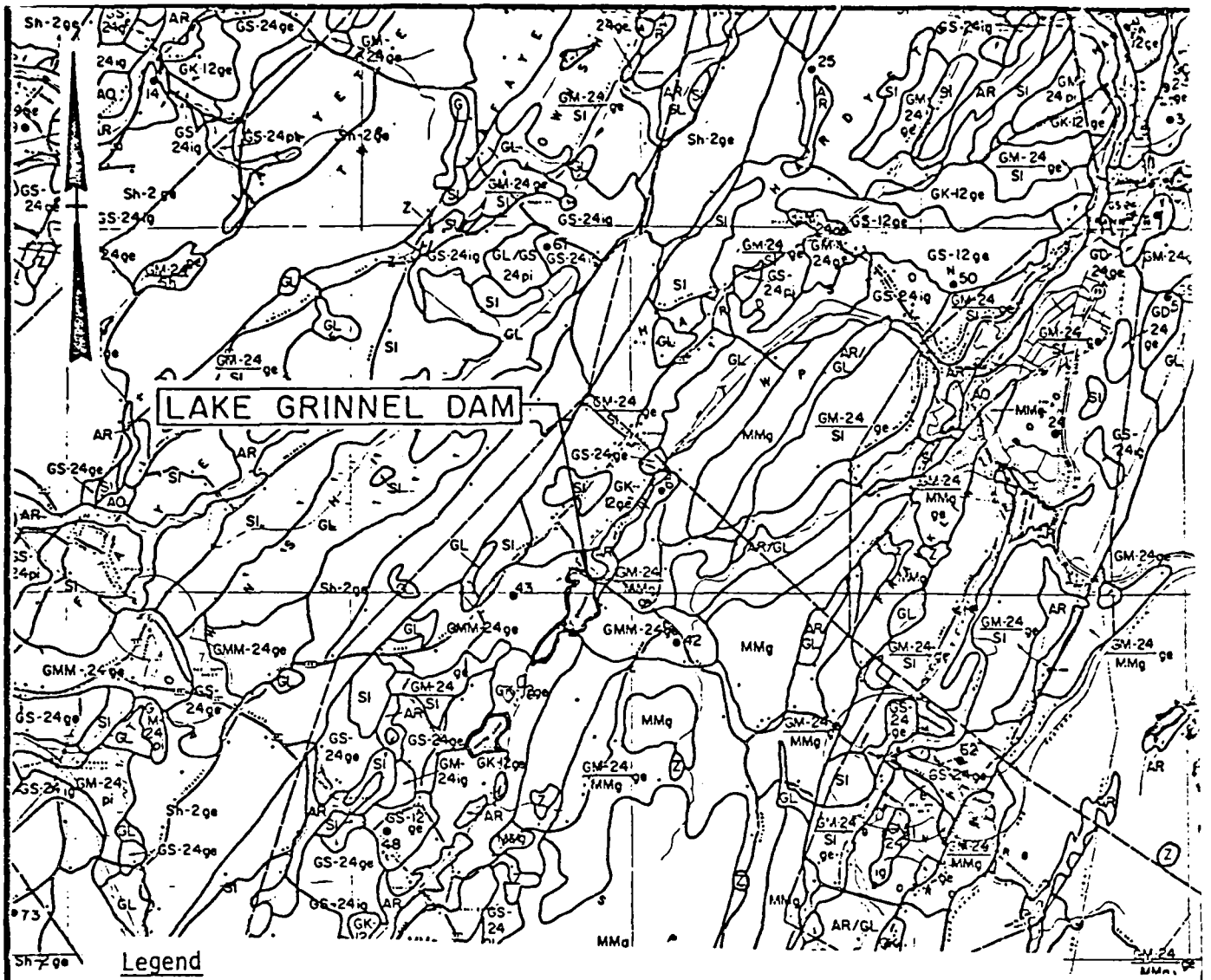


PLATE 1

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS KEY MAP LAKE GRINNEL DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	SCALE: NONE DATE: FEB. 1981



STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS VICINITY MAP LAKE GRINNEL DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	SCALE: AS SHOWN DATE: FEB. 1981



Legend

AR	Recent alluvium composed of stratified materials found adjacent to the present stream courses.
GMM-24	Glacial recessional moraine. Unassorted and heterogeneous mixture of materials deposited at the outer edge of the ice sheet during the Wisconsin stage of continental glaciation.
GK-12	Glacial kames composed of stratified material deposited during the Wisconsin glacial period.

Note: Information taken from Rutgers University, Soil Survey of New Jersey, Report No. 11, Sussex County, November 1953 and Geologic Map of New Jersey prepared by J.V. Lewis and H. Kummel 1910-1912, revised by H. B. Kummel 1931 and M. Johnson 1950.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY.

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY.

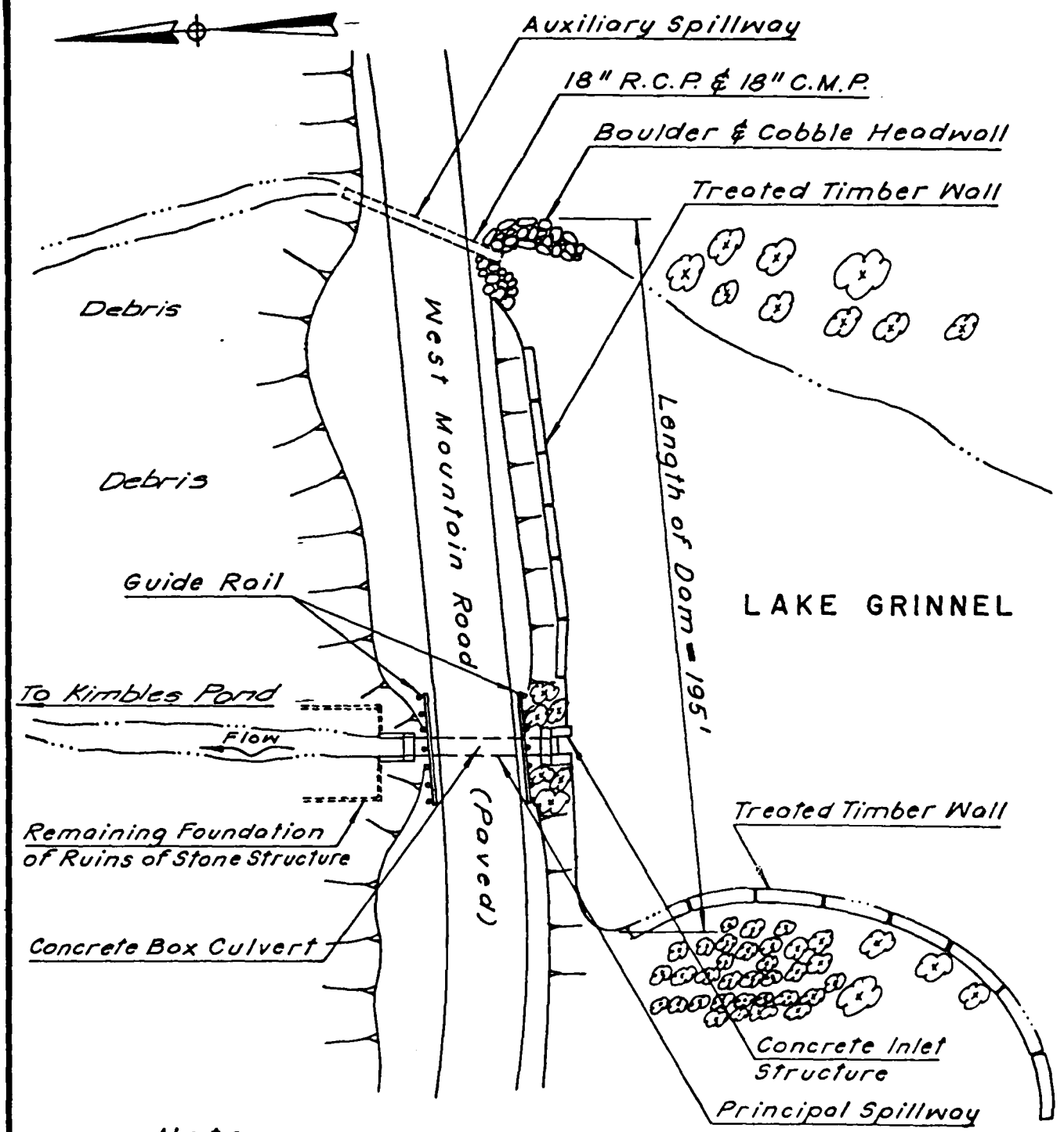
INSPECTION AND EVALUATION OF DAMS

SOIL MAP

LAKE GRINNEL DAM

SCALE: NONE

DATE: FEB.1981



Note:
Information taken from field inspection December 19, 1980

PLATE 4

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS GENERAL PLAN LAKE GRINNEL DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D.N.J.00289 | SCALE: NONE DATE: MARCH 1981

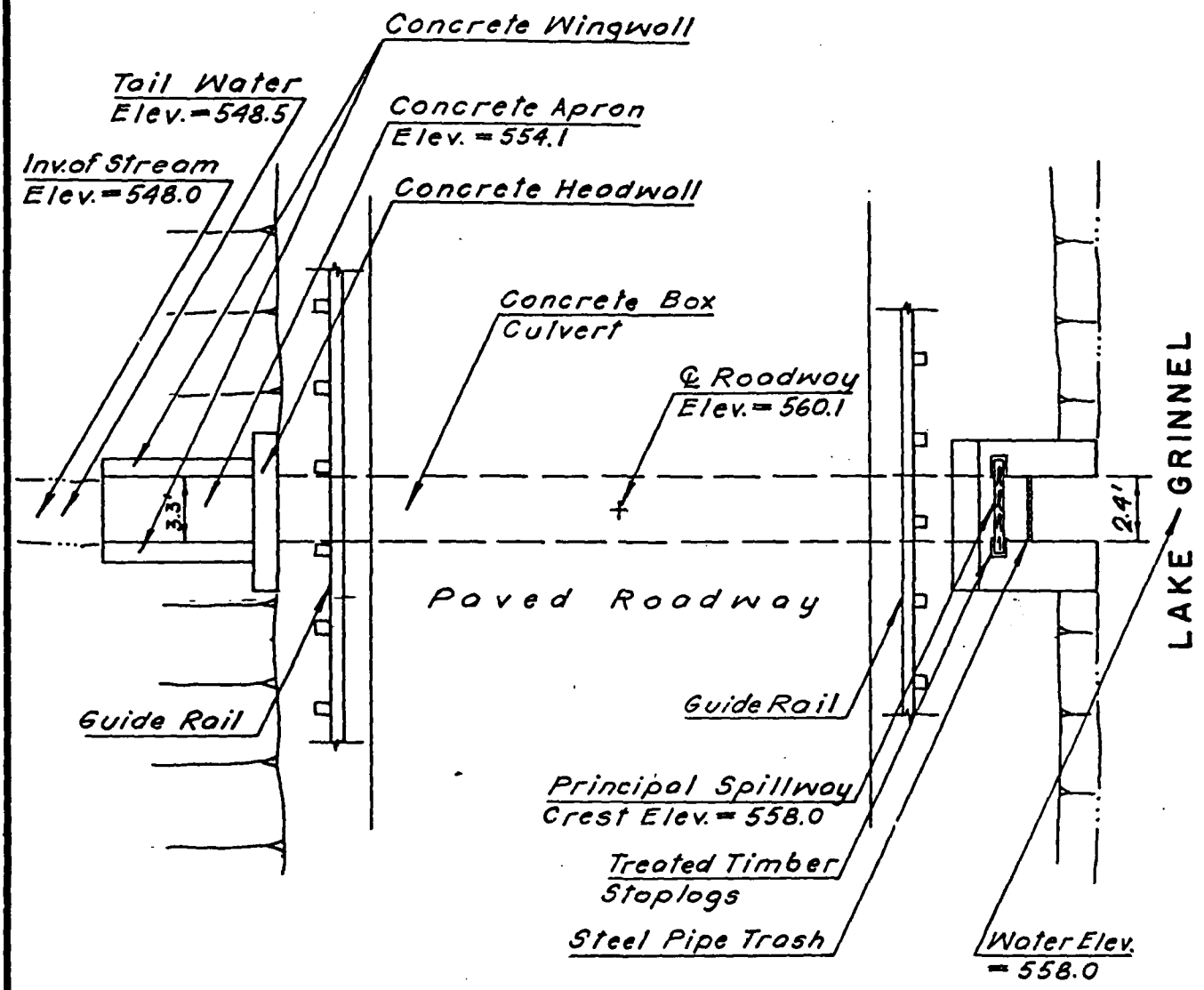


PLATE 5

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

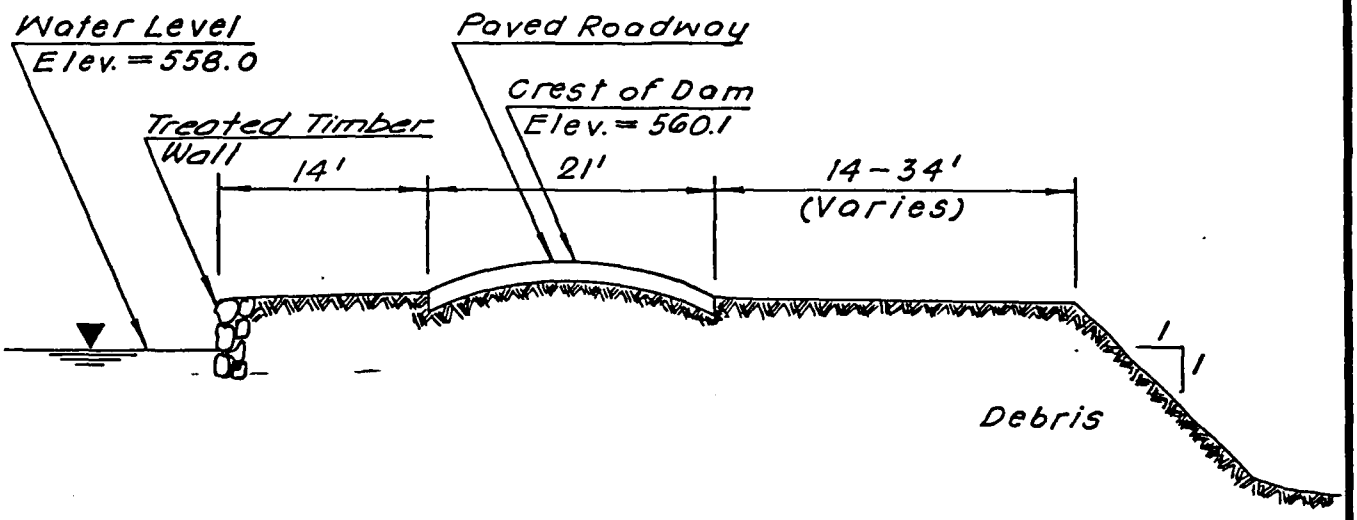
INSPECTION AND EVALUATION OF DAMS

SPILLWAY PLAN
LAKE GRINNEL DAM

I.D. N.J. 00289

SCALE: NONE

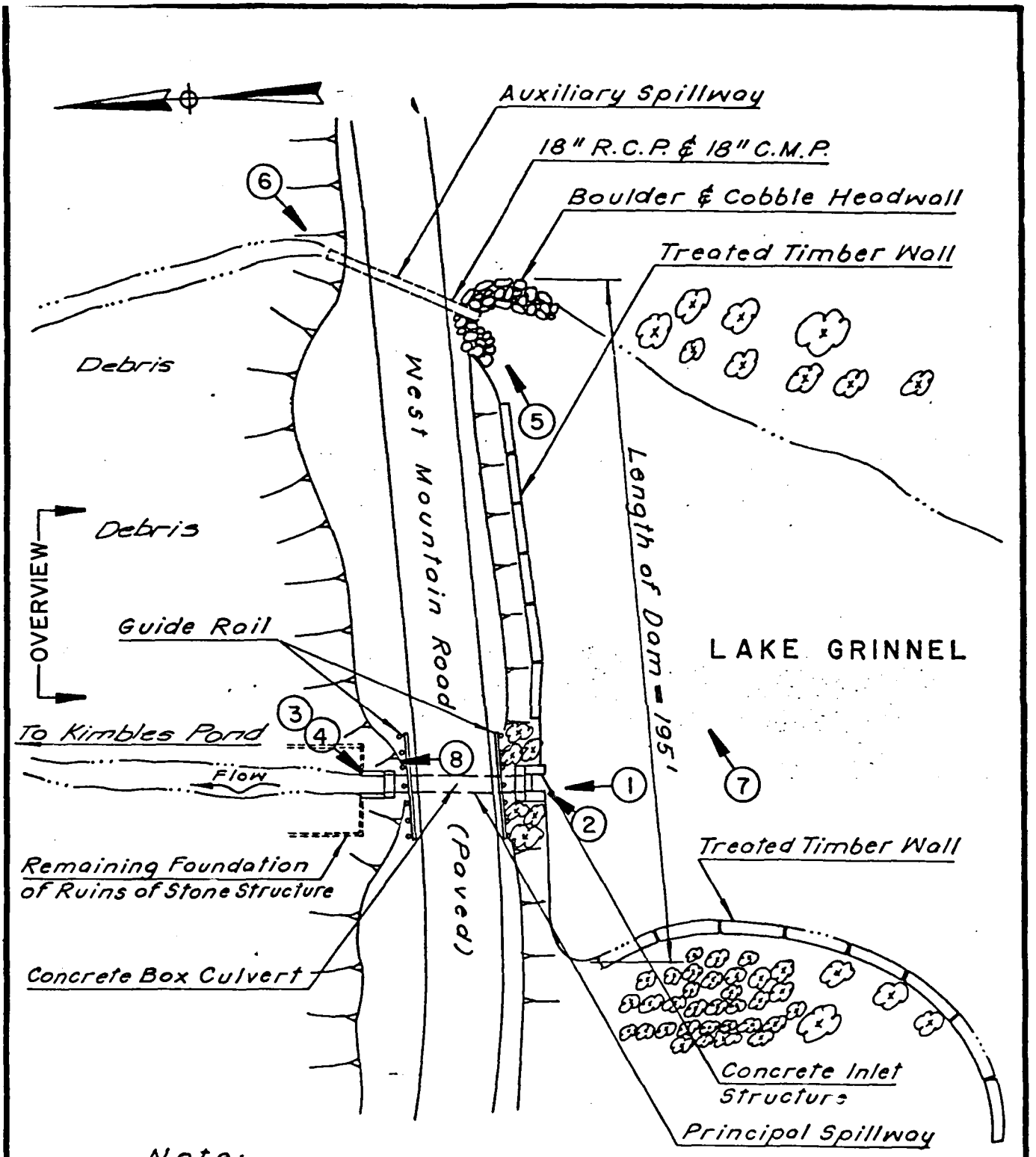
DATE: MARCH. 1981



TYPICAL DAM SECTION

PLATE 6

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS TYPICAL DAM SECTION LAKE GRINNEL DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. N.J. 00289 / SCALE: NONE DATE: MARCH 1981



Note:
Information taken from field inspection December 19, 1980

PLATE 7

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS PHOTO LOCATION PLAN LAKE GRINNEL DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D.N.J.00289 / SCALE: NONE DATE: MARCH 1981

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List

Visual Inspection

Phase I

Name of Dam Lake Grinnel Dam County Sussex State N.J. Coordinators NJDEP

Date(s) Inspection 12/19/80 Weather Sunny Temperature 25°F.

Pool Elevation at time of Inspection 558.0 M.S.L. Tailwater at Time of Inspection 548.5 M.S.L.

Inspection Personnel:

John Gribbin	W. Carson	
Charles Osterkorn	Richard McDermott	
Daniel Buckelew		

John Gribbin Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Paved roadway on crest generally sound with slight deterioration at principal spillway. Upstream and downstream sides overgrown with briars and trees. Downstream side was irregularly graded and contained significant accumulations of debris.	Trees and adverse vegetation should be removed. Debris should be removed from embankment.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appeared sound.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

EMBANKMENT

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion observed on downstream side to the right of auxiliary spillway. Erosion appeared to be due to surface runoff.	Eroded area should be properly filled and stabilized.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical: generally level. Horizontal: slightly curved with irregular crest width.	
RIPRAP	None observed.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES IN OUTLET CONDUIT	Same as principal spillway.	
INTAKE STRUCTURE	N.A.	
OUTLET STRUCTURE	N.A.	
OUTLET CHANNEL	Box culvert, same as principal spillway.	
GATE AND GATE HOUSING	Timber stoplogs at upstream end of principal spillway structure.	

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	Weir formed by timber stoplogs. Stoplogs appeared to be in satisfactory condition.	
APPROACH CHANNEL	N.A.	
DISCHARGE CULVERT	Concrete box culvert appeared sound. Interior surfaces appeared to be rough. Leakage emerging through vertical wall near upstream end. Leakage appeared to be due to melting snow on the roadway.	
DISCHARGE CHANNEL	Principal spillway discharges directly into ruins of stone masonry building. Ruins contained significant accumulation of debris and appeared to be marginally stable.	Debris should be cleared from stone masonry ruins and ruins should be investigated for structural stability.

AUXILIARY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	N.A.	
APPROACH CHANNEL	Channel formed by stone rubble walls appeared to be in satisfactory condition.	
DISCHARGE CULVERT	Culvert appeared generally sound. Upstream end was CMP and downstream end was RCP.	Location of transition could not be observed nor could stability of junction of CMP and RCP be assessed.
DISCHARGE CHANNEL	Downstream end of culvert emerged from embankment about midway up slope. Discharge flowed over boulders to natural stream at toe of slope. Boulders obscured by snow and ice.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Shore slopes wooded and steep, 50% to 100%.	
SEDIMENTATION	Unknown.	
STRUCTURES ALONG BANKS	Homesites were observed around entire reservoir.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTION, DEBRIS, ETC.)	Natural stream with wooded, moderately sloping flood plain. The stream contains boulders and debris in its bed.	
SLOPES	Stream banks about 3' high with moderately sloping terrain beyond the banks.	
STRUCTURES ALONG BANKS	No structure observed in immediate vicinity of dam. Farm related structures including one dwelling observed about 4700' downstream.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM			REMARKS
DAM	-	PLAN	Not Available
		SECTIONS	
SPILLWAY	-	PLAN	Not Available
		SECTIONS	
		DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS			Not Available
OUTLETS	-	PLAN	Not Available
		DETAILS	
		CONSTRAINTS	
		DISCHARGE RATINGS	
HYDRAULIC/HYDROLOGIC DATA			Not Available
RAINFALL/RESERVOIR RECORDS			Not Available
CONSTRUCTION HISTORY			Not Available
LOCATION MAP			Not Available

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM INSTABILITY SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	Not Available
MODIFICATIONS	Not Available
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Not Available
MAINTENANCE OPERATION RECORDS	Not Available

APPENDIX 2

Photographs

PHOTO 1
PRINCIPAL SPILLWAY

PHOTO 2
STOPLOG FORMING CREST OF PRINCIPAL SPILLWAY

LAKE GRINNEL DAM
19 DECEMBER 1980

PHOTO 3

CONCRETE TRAINING WALLS AT DOWNSTREAM END OF PRINCIPAL SPILLWAY DISCHARGE CULVERT

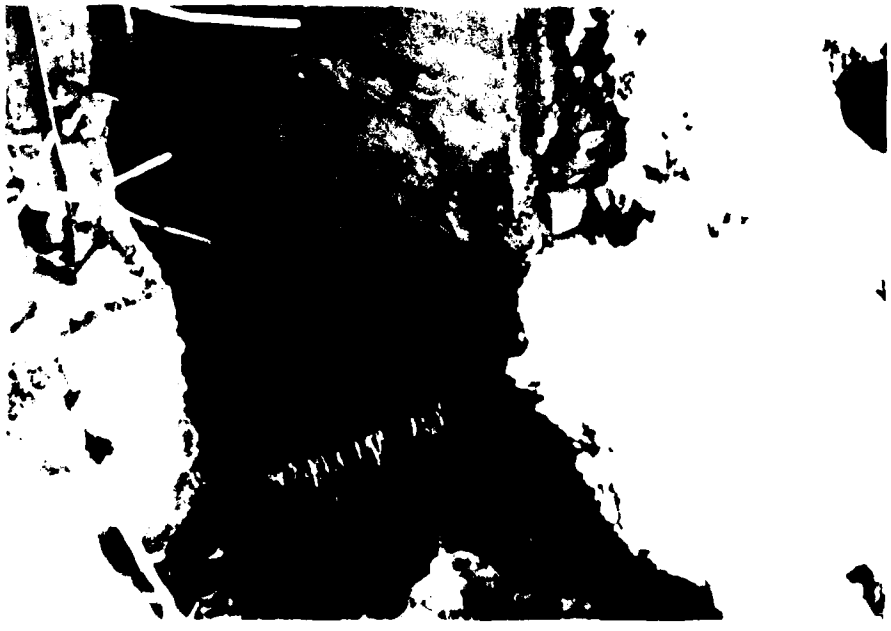


PHOTO 4

OUTLET FOR PRINCIPAL SPILLWAY DISCHARGE CULVERT

LAKE GRINNEL DAM

19 DECEMBER 1980

PHOTO 5
INTAKE END OF AUXILIARY SPILLWAY

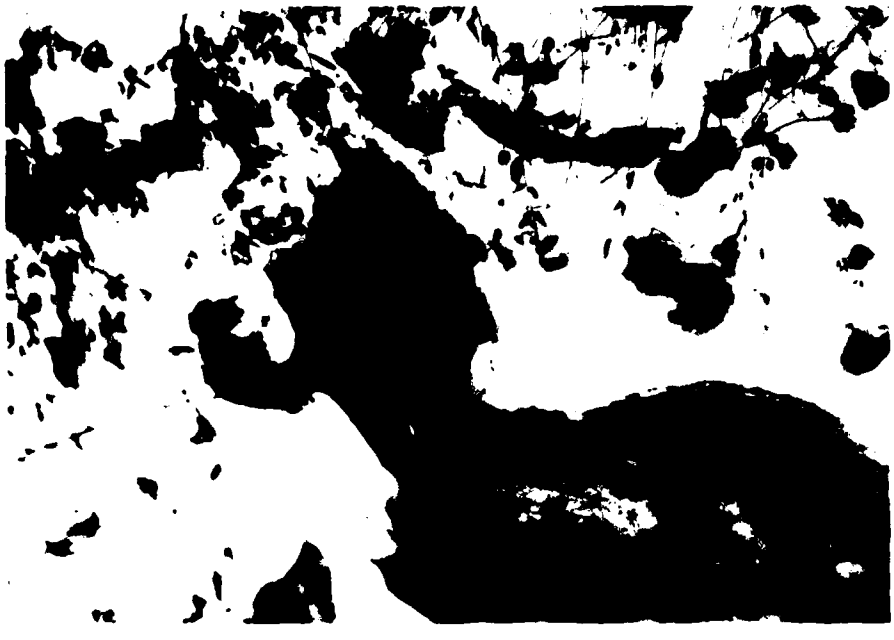


PHOTO 6
OUTLET END OF AUXILIARY SPILLWAY

LAKE GRINNEL DAM
19 DECEMBER 1980

PHOTO 7

UPSTREAM FACE OF DAM

PHOTO 8

REMAINS OF STONE MASONRY STRUCTURE WITH
DOWNSTREAM FLOOD PLAIN IN BACKGROUND

LAKE GRINNEL DAM

19 DECEMBER 1980

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Undeveloped, partially wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 558.0 (150 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 562.9

ELEVATION TOP DAM: 560.1

PRINCIPAL SPILLWAY CREST: Stoplogs in concrete structure

a. Elevation 558.0

b. Type Sharp crested weir

c. Width 0.2 foot

d. Length 2.4 feet

e. Location Spillover Upstream side of dam

f. Number and Type of Gates One set of stoplogs

AUXILIARY SPILLWAY CREST: Rock-lined approach channel to culvert

a. Elevation 558.0

b. Type Culvert: 18-inch pipe

c. Width N.A.

d. Length 18" diameter

e. Location Spillover Downstream side of dam

f. Number and Type of Gates None

OUTLET WORKS: Included in principal spillway

a. Type Timber stoplogs

b. Location Upstream end of principal spillway structure

c. Entrance Invert 554.1

d. Exit Invert 554.1

e. Emergency Draindown Facilities: Remove stoplogs

HYDOMETEOROLOGICAL GAGES: None

a. Type N.A.

b. Location N.A.

c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake Stage Equal to Top of Dam) 30 c.f.s.

APPENDIX 4

Hydraulic/Hydrologic Computations

STORCH ENGINEERS

Project LAKE GRINNEL DAM

Sheet 1 of 9

Made By JLP Date 3-11-81

Chkd By JG Date 4/3/81

HYDROLOGY

HYDROLOGIC ANALYSIS – RUNOFF HYDROGRAPH WILL BE DEVELOPED BY THE HEC-1-DAM COMPUTER PROGRAM USING THE SCS TRIANGULAR HYDROGRAPH WITH CURVILINEAR TRANSFORMATION.

DRAINAGE AREA = 2.77 SQ. MI.

INFILTRATION DATA

INITIAL INFILTRATION = 1.5 inches

CONSTANT INFILTRATION: 0.15 inches/hour

1) TIME OF CONCENTRATION (SCS-TR55)

SCS-TR55

OVERLAND FLOW:

L = 5800'
A. ELEV. = 460'
S = 7.90%
V = 0.7 f.p.s.
T_c = 2.3 Hr.

TIME OF CONCENTRATION (Con't.)

SCS-TR55

$L = 3000'$
Δ ELEV. $= 60'$
$S = 2.00\%$
$V = 2.8$ f.p.s.
$T_c =$ 0.3 HR.

CHANNEL FLOW: NEGLECT

$T_c =$ 2.6 HR.

2) BY KERBY HANDBOOK OF HYDROLOGY BY CHOW

$$T_c^{2.14} = 2/3\, Ln/\sqrt{S}$$

where: T_c = overland time of concentration (min)
L = length of overland flow (ft.)
n = Mannings coeff. ($n = 0.4$)
S = Slope (ft./ft.)

$$T_c^{2.14} = \frac{2/3\,(5800)0.4}{\sqrt{0.079}} = 0.90 \text{ HR}$$

$$T_c^{2.14} = \frac{2/3\,(3000)0.4}{\sqrt{0.02}} = 0.94 \text{ HR.}$$

Total $T_c = 1.84$ HR.

TIME OF CONCENTRATION (con't.)

3.) DESIGN OF SMALL DAMS pg. 71

$$T_c = \left(\frac{11.9\,L^3}{H}\right)^{0.385}$$ where:

T_c = time of concentration (hours)
L = length of watercourse (miles)
H = elevation difference

$L = 5800' = 1.09$ miles
$H = 460'$
$T_c =$

$$T_c = \left(\frac{11.9\,(1.09)^3}{460}\right)^{0.385} = 0.27$$

$L = 3000'$
$H = 60'$
$T_c =$

$$T_c = \left(\frac{11.9\,(0.57)^3}{60}\right)^{0.385} = 0.28$$

$T_c = 0.55$ HR.

FOR COMPUTER USE INPUT

LAG TIME use $t_c = 1.66$

LAG = 60% T_c = 1.00 HOUR

STORCH ENGINEERS

Project LAKE GRINNEL DAM

Sheet 4 of 9

Made By JLP Date 3-11-81

Chkd By JG Date 4/3/81

SQUARE 4 X 4 TO THE INCH

LAKE STORAGE VOLUME

WATER SURFACE ELEVATION	AREA (ACRES)
548.3	0
558.0	46.4
560.0	53.3
580.0	94.1
600.0	236.5

HEC-1-DAM COMPUTER PROGRAM WILL DEVELOP STORAGE CAPACITY FROM SURFACE AREAS AND ELEVATIONS.

INFORMATION TAKEN FROM USGS QUADRANGLE.

Printed in U.S.A.

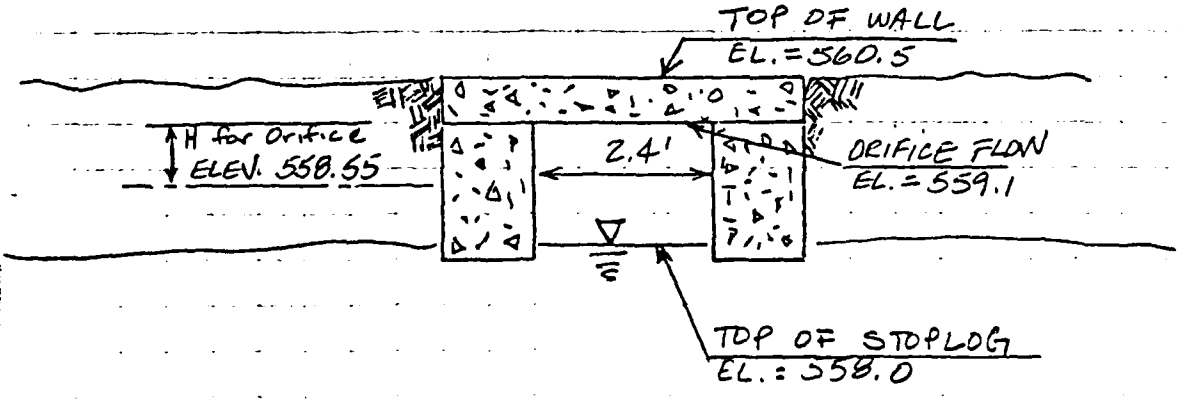
PRECIPITATION

24 HOUR, 100-YEAR RAINSTORM DISTRIBUTION FOR LAKE GRINNEL DAM

TIME (HR.)	RAIN (inches)
1	0.075
2	0.075
3	0.075
4	0.075
5	0.075
6	0.075
7	0.075
8	0.075
9	0.075
10	0.075
11	0.075
12	0.075
13	0.15
14	0.15
15	0.15
16	0.33
17	0.65
18	3.00
19	0.65
20	0.33
21	0.33
22	0.15
23	0.15
24	0.15
	7.09 inches

HYDRAULICS

THE SPILLWAY AT LAKE GRINNEL DAM CONSISTS A BOX CULVERT UNDER THE EMBANKMENT WITH AN INLET STRUCTURE AT THE UPSTREAM END FITTED WITH TIMBER STOPLOGS. THE CULVERT DISCHARGES INTO THE RUINS OF A STONE BUILDING. AT THE EXTREME RIGHT END OF THE DAM THERE IS A SECONDARY SPILLWAY CONSISTING OF A PIPE CULVERT UNDER THE EMBANKMENT. THE BOX CULVERT WILL BE TREATED AS A SHARP CRESTED WEIR UNTIL ORIFICE FLOW CONTROLS. THE SECONDARY SPILLWAY CAPACITY WILL BE DEVELOPED USING HIGHWAY CULVERT CHARTS, INLET OR OUTLET CONTROL, WHICHEVER GOVERNS.



PRINCIPAL SPILLWAY

STORCH ENGINEERS

Project LAKE GRINNEL DAM Made By JLP Date 3-12-81 Sheet 7 of 9

Chkd By JG Date 4/3/81

SPILLWAY

STAGE - DISCHARGE TABULATION

ELEV.	PRINCIPAL SPILLWAY								SECONDARY SPILLWAY		
	WEIR FLOW				ORIFICE FLOW				INLET CONTROL		
	C	L (ft)	h (ft)	Q (cfs)	A (ft^2)	2g	h (ft)	Q (cfs)	HW/D	Q (cfs)	TOTAL Q (cfs)
557.0											
557.5									0.66	3.5	3.5
558.0									1.0	6.5	6.5
558.5	3.32	2.4	0.5	2.8					1.3	9.0	11.8
559.1	3.32	2.4	1.1	9.2	2.64	64.4	0.55	9.4	1.66	11.0	20.2
559.5					2.64	64.4	0.95	12.4	2.0	12.5	24.9
560.0					2.64	64.4	1.45	15.3	2.33	14.0	29.3
560.5					2.64	64.4	1.95	17.7	2.66	15.0	32.7
561.0					2.64	64.4	2.45	19.9	3.0	17.0	36.9
562.0					2.64	64.4	3.45	23.6	3.66	19.0	42.6
563.0					2.64	64.4	4.45	26.8	4.33	21.0	47.8
564.0					2.64	64.4	5.45	29.7	5.0	24.0	53.7

STORCH ENGINEERS

Project LAKE GRINNEL DAM

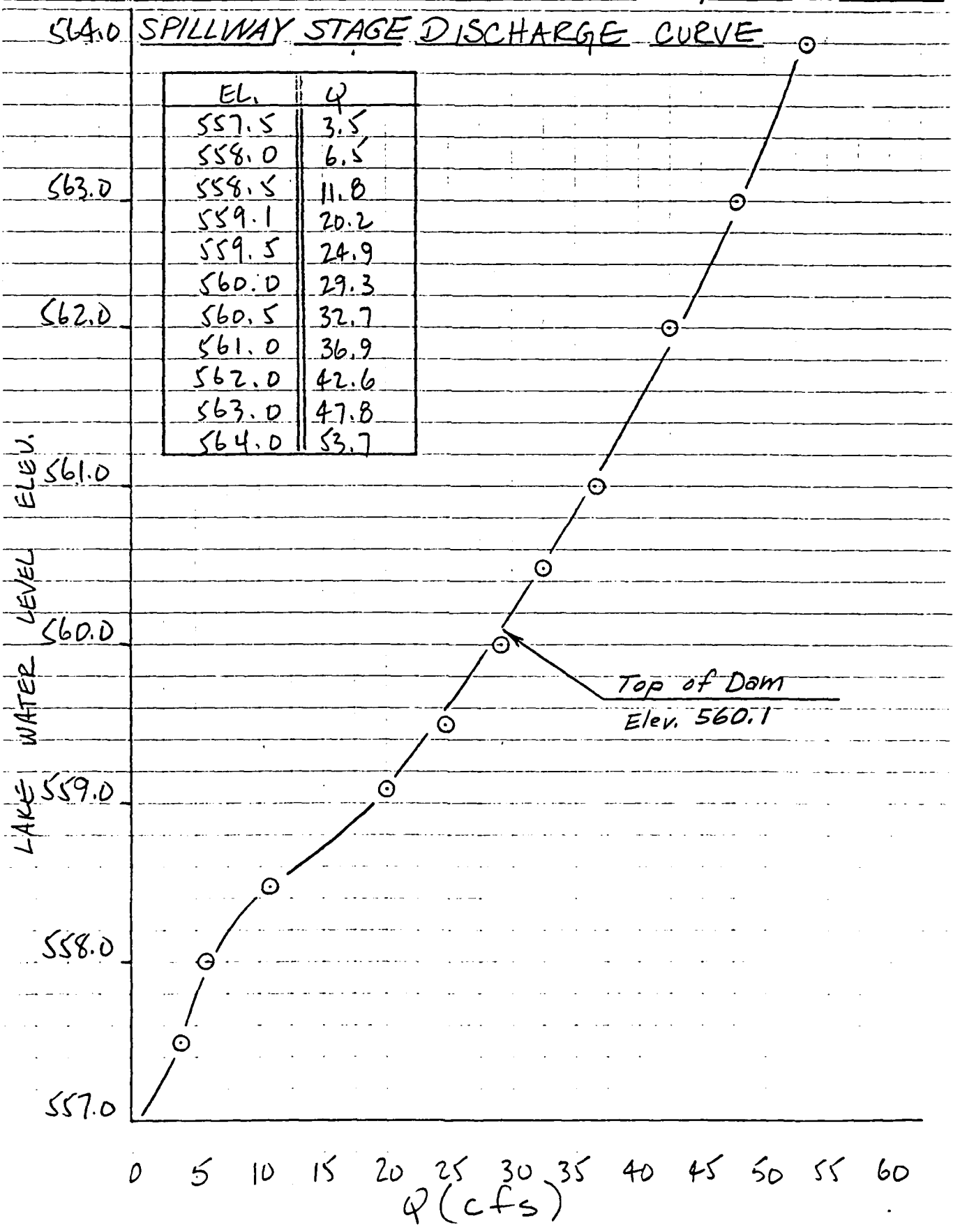
Sheet 8 of 9

Made By JLP Date 3-12-81

Chkd By JG Date 4/3/81

SPILLWAY STAGE DISCHARGE CURVE

EL.	Q
557.5	3.5
558.0	6.5
558.5	11.8
559.1	20.2
559.5	24.9
560.0	29.3
560.5	32.7
561.0	36.9
562.0	42.6
563.0	47.8
564.0	53.7



DRAWDOWN

Drawdown of the lake will be assumed to be accomplished by pulling the spillway stoplogs, 2.0 feet at a time.

$$Q = CLH^{3/2}$$

$$= (3.33)(2.4)(2.0)^{3/2}$$

$$= \underline{22.6} \text{ cfs}$$

TIME OF DRAWDOWN

$$T_d = \frac{\text{storage}}{\text{Avg. discharge} - \text{Inflow}}$$

$$= \frac{150 \times 43560}{22.6 - 2.8} \times \frac{1}{3600}$$

$$= 91.7 \text{ hours}$$

$$= 3.8 \text{ days}$$

HEC - 1 - DAM PRINTOUT

Overtopping Analysis

```
1A1                         NATIONAL DAM SAFETY PROGRAM
A2                          LAKE GRINNEL, NEW JERSEY
A3                          100 YEAR STORM ROUTING
B    300       0      15                                    0       0       4
B1     5
J      1       1       1
J1     1
K      0    LAKE                              0       0       1
K1         INFLOW HYDROGRAPH TO LAKE GRINNEL DAM
M      0       2     2.8                   2.8       0
O     96
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.038   0.038
O1 0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038
O1 0.083   0.083   0.083   0.083   0.163   0.163   0.163   0.163   0.750   0.750
O1 0.750   0.750   0.163   0.163   0.163   0.163   0.083   0.083   0.083   0.083
O1 0.083   0.083   0.083   0.083   0.038   0.038   0.038   0.038   0.038   0.038
O1 0.038   0.038   0.038   0.038   0.038   0.038
T                                                   1.5     0.15
W2           1.00
X    -1.0   -0.05     2.0
K      1     DAM
K1         ROUTE DISCHARGE THROUGH DAM
Y                                   1       1
Y1     1                                            -558.0      -1
Y4 557.0   557.5   558.0   558.5   559.1   560.0   560.5   561.0   562.0   564.0
Y5     0     3.5     6.5    11.8    20.2    29.3    32.7    36.9    42.6    53.7
$A     0    46.4    53.3    94.1   236.5
$E 548.3   558.0   560.0   580.0   600.0
$$ 558.0
$D 560.1    2.63     1.5     195
K      1       1                                       1
K1       CHANNEL ROUTING REACH 1
Y                                   1       1
Y1     1
Y6   0.1   0.035     0.1   548.3     580     400  0.0043
Y7     0     580      80     560     140     551     146   548.3     166   548.3
Y7   172     551     200     560     310     580
K      1       2                                       1
K1     CHANNEL ROUTING REACH 2
Y                                   1       1
Y1     1
Y6   0.1   0.035     0.1     540     580    4300  0.0019
Y7     0     580     150     560     245     542     250     540     260     540
Y7   265     542     360     560     500     580
K     99
A
```

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE DISCHARGE THROUGH DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-558.	-1

STAGE	557.00	557.50	558.00	558.50	559.10	560.00	560.50	561.00	562.00	564.00
FLOW	0.00	3.50	6.50	11.80	20.20	29.30	32.70	36.90	42.60	53.70
SURFACE AREA=	0.	46.	53.	94.	237.					
CAPACITY=	0.	150.	250.	1704.	4903.					
ELEVATION=	548.	558.	560.	580.	600.					

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
558.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
560.1	2.6	1.5	195.

PEAK OUTFLOW IS 2469. AT TIME 19.25 HOURS

NATIONAL DAM SAFETY PROGRAM
LAKE GRINNEL, NEW JERSEY
100 YEAR STORM ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO LAKE GRINNEL DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	2.80	0.00	2.80	0.00	0.000	0	0	0

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.50	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 1.00

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

0
END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	7.12	4.33	2.79	33309.
										(181.)	(110.)	(71.)	(943.21)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1
				1.00
HYDROGRAPH AT	LAKE	2.80	1	3367.
		(7.25)		(95.34)(
ROUTED TO	DAM	2.80	1	2469.
		(7.25)		(69.93)(
ROUTED TO	1	2.80	1	2460.
		(7.25)		(69.67)(
ROUTED TO	2	2.80	1	2321.
		(7.25)		(65.72)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	558.00	558.00	560.10
STORAGE	150.	150.	255.
OUTFLOW	7.	7.	30.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	562.91	2.81	413.	2469.	14.75	19.25	0.00

PLAN 1 STATION 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	2460.	555.8	19.25

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	2321.	550.5	19.50

APPENDIX 5

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